CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

FOREIGN TRIP REPORT

SUBJECT: 13th World Conference on Earthquake Engineering
Administrative Item: 20.06002.01.102.403

DATE/PLACE: July 31–August 6, 2004
Vancouver, Canada

AUTHORS: Luis Ibarra

DISTRIBUTION:

CNWRA	NRC	SwRI
W. Patrick	D. DeMarco	Record Copy B, IQS
CNWRA Directors	E. Whitt	
CNWRA Element Mgrs	B. Meehan	
MGFE Staff	B. Ford	
L. Gutierrez	W. Reamer	
P. Maldonado	B. Leslie	
	M. Nataraja	
	A. Csontos	
	D. Galvin	
	T. Ahn	
	B. Jagannath	
	K. Stablein	
	M. Bailey	
	Y. Kim	
	T. McCartin	
	T. Kobetz	
	D. Brooks	
	G. Hatchett	
	R. Johnson	
	L. Kokajko	
	E. Collins	
	F. Brown	
	J. Guttmann	
	D. Dancer	
	D. Rom	
	NRC Foreign Travel Group	

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

FOREIGN TRIP REPORT

Subject

13th World Conference on Earthquake Engineering
(Administrative Item: 20.06002.01.102.403)

Dates of Travel and Countries/Organizations Visited

July 31–August 6, 2004
Vancouver, Canada

Author, Title, and Agency Affiliation

Luis Ibarra
Senior Research Engineer
Center for Nuclear Waste Regulatory Analyses (CNWRA)

Background and Purpose

The purpose of the trip was to attend the13th World Conference on Earthquake Engineering (WCEE), an international conference that takes place every four years and addresses a broad spectrum of topics pertaining to seismic and structural engineering (see the technical program in Attachment A). The conference provided an opportunity for the CNWRA staff member to make a presentation titled "Global Collapse of Deteriorating MDOF Systems." Attendance at this conference also allowed the CNWRA staff member to learn about new designs and methodologies, some of which are directly related to the design and seismic criteria for nuclear facilities. This type of exposure increases the credibility of the CNWRA staff in providing effective technical assistance to the U.S. Nuclear Regulatory Commission (NRC) in its oversight of nuclear waste disposal activities.

Discussion

The paper presented by the CNWRA staff member, "Global Collapse of Deteriorating MDOF Systems," proposes a methodology for evaluating global sideways collapse based on a relative intensity measure in multi-degree-of-freedom structures. This relative intensity is the ratio of ground motion intensity to a structural strength parameter, which is increased until the response of the system becomes unstable. The largest relative intensity is referred to as "collapse capacity." Deteriorating hysteretic models are used to represent the cyclic behavior of structural components. Applications of the proposed collapse methodology for developing collapse fragility curves and for evaluating the mean annual frequency of collapse are presented. Although the paper is derived from the doctoral dissertation of the staff member, several of the concepts are closely related to the performance based design methodology utilized for evaluating the structural systems and components for the proposed repository at Yucca Mountain.

The staff member is also the coauthor of two more articles in the WCEE conference (1) "Evaluation of P-Delta Effects in Non-Deteriorating MDOF Structures from Equivalent SDOF Systems," and (2) "Seismic Demands and Capacities of Single-Story and Low-Rise Multi-Story Woodframe Structures." The first paper assesses the destabilizing effects of P-Delta effects in highly inelastic structures when subjected to seismic excitations. The second paper summarizes a systematic process for the evaluation of seismic demands imposed by ground motions on single-story and low-rise woodframe structures. The study shows that comprehensive demand results developed for SDOF systems also can be applied with confidence to low-rise MDOF systems though the use of an equivalent SDOF system.

The conference also provided the opportunity to learn about the work developed by other researchers and practitioners in the area of earthquake and structural engineering. Some of the presented papers are directly related to the nuclear industry.

The paper presented by G. Backblom, et al, "Earthquake Data and Modeling to Study the Effects of Future Earthquakes on a Final Repository of Spent Nuclear Fuel in Sweden," concludes that from a seismic perspective an underground disposal is preferred to any surface disposal. The studies corroborate that for the Swedish repository, major displacements take place at reactivating faults.

In the paper "Evaluation of Seismic Capacities of Korean Nuclear Power Plant Structures by Seismic Fragility Analysis," S.G. Cho and others presented an improved response spectrum shape factor considering the multimode effects and discussed its impact on the seismic fragility analysis of shearwall structures. The authors utilized the original High Confidence of Low Probability of Failure (HCLPF) approach, in which aleatory variability and epistemic uncertainty were computed separately.

N. Abrahamson presented the paper "The Need for Upper Bounds on Seismic Ground Motion," in which the need for truncating the ground motion probability distribution utilized to evaluate seismic hazard at very long return periods was discussed. The importance of the issue of upper bounds on earthquake ground motions has been raised from the experience of the Yucca Mountain and PEGASOS[1] seismic hazard studies.

The paper presented by Y. Choun, et al, "Improvement of Seismic Safety of Nuclear Power Plants by Increase of Equipment Seismic Capacity," shows that the increase of seismic capacity of the equipment can reduce the core damage frequency significantly. Therefore, the seismic capacity of the operating nuclear power plants can be significantly improved. In this work, the original HCLPF methodology was utilized to develop the seismic fragility curves of the structural systems and components.

Orbovic and others presented the paper "Seismic Performance-Based Evaluation of Nuclear Facility Structures," in which FEMA–356 evaluation acceptance criteria are presented in terms of U.S. Department of Energy (DOE)–1020 risk reduction factor.

There were more papers related to the nuclear industry that are not described above. For instance, Japanese institutes presented several papers about the development of seismic

[1]Probabilistic seismic hazard analysis for the Swiss nuclear power plants.

isolations systems for the next generation of nuclear power plants. In addition, several of the studies not directly related to the nuclear industry presented approaches and solutions to structural problems that may be used for CNWRA review of DOE submittals.

Conclusions

Attendance to the conference fulfilled the objectives of keeping the staff in contact with the state of the art in structural and earthquake engineering. The presentations provided insight of the new designs and methodologies that researchers and engineers are performing on structural systems similar to those evaluated by the NRC at the CNWRA.

Pending Actions

None.

Signature and Date

Luis Ibarra
Sr. Research Engineer, CNWRA

Sep 08, 2004
Date

Concurrence Signature and Date

Asadul Chowdhury
Manager of MGFE, CNWRA

9-8-04
Date

Budhi Sagar
Technical Director, CNWRA

9-9-04
Date

ATTACHMENT A

Session Names

Major Topic Categories

MTC 1: EARTHQUAKE RISK REDUCTION
MTC 2: EARTHQUAKE ENGINEERING PRACTICE
MTC 3: SOCIAL AND ECONOMIC ISSUES
MTC 4: ENGINEERING SEISMOLOGY
MTC 5: GEOTECHNICAL ENGINEERING
MTC 6: STRUCTURAL ENGINEERING - ANALYSIS
MTC 6: STRUCTURAL ENGINEERING - BRIDGES
MTC 6: STRUCTURAL ENGINEERING - CONCRETE
MTC 6: STRUCTURAL ENGINEERING - CONTROL
MTC 6: STRUCTURAL ENGINEERING - EXPERIMENTAL
MTC 6: STRUCTURAL ENGINEERING - MASONRY AND TIMBER
MTC 6: STRUCTURAL ENGINEERING - STEEL
MTC 6: STRUCTURAL ENGINEERING - MISCELLANEOUS
MTC 7: LIFELINE SYSTEMS
MTC 8: DESIGN CRITERIA AND METHODS
MTC 9: LESSONS FROM RECENT EARTHQUAKES
MTC 10: OTHER ISSUES

Special Theme Sessions

MTC 11: SEISMIC ASPECTS OF LARGE DAMS
MTC 12: BUCKLING RESTRAINED BRACES FOR RATIONAL SEISMIC DESIGN
MTC 13: SEISMIC RISK REDUCTION OF OPERATIONAL AND FUNCTIONAL COMPONENTS OF BUILDINGS
MTC 14: INDIGENOUS EARTHQUAKE-RESISTANT TECHNOLOGIES
MTC 15: SITE CHARACTERIZATION FOR SITE EFFECTS STUDIES USING AMBIENT VIBRATIONS
MTC 16: USING THE NETWORK FOR EARTHQUAKE ENGINEERING SIMULATION (NEES) COLLABORATORY TO ADVANCE EARTHQUAKE ENGINEERING
MTC 17: HYBRID EXPERIMENTAL AND ANALYTICAL SIMULATION IN EARTHQUAKE ENGINEERING
MTC 18: FUTURE OF BUILDING CODES
MTC 19: SEISMIC RESPONSE OF IRREGULAR STRUCTURES
MTC 20: STRONG MOTION PREDICTION CONSIDERING THE EFFECTS OF SURFACE GEOLOGY
MTC 21: SEISMIC STRUCTURAL DESIGN IN REGIONS OF MODERATE SEISMICITY
MTC 22: CENTRIFUGE-BASED LIQUEFACTION STUDIES

Programme at a Glance

	SUNDAY	MONDAY	TUESDAY
07:30		07:30-17:30 **Registration** Convention Lobby Convention Level	07:30-17:30 **Registration** Convention Lobby Convention Level
08:30		08:15-10:30 **Keynote Presentations** MK: W.D. Liam Finn, Thomas D. O'Rourke Jorge Gutierrez Exhibit Hall A Convention Level	**Keynote Presentations** TUK: Hugo Bachmann, Tsuneo Katayama Exhibit Hall A Convention Level
10:00			***Break / Poster Session P2 / Exhibits*** Exhibit Halls B&C Convention Level
10:30		***Break / Poster Session P1 / Exhibits***	**Technical Sessions TU1** Convention Level & Meeting Room Level
12:00	12:00-19:30 **Registration** Convention Lobby Convention Level	11:00-12:30 **Technical Sessions M1** Convention Level & Meeting Room Level	Lunch/ **Poster Session P2** / Exhibits Exhibit Halls B&C Convention Level
12:30		**Lunch/ Poster Session P1 / Exhibits** Exhibit Halls B&C Convention Level	
14:00		**Technical Sessions M2** Convention Level & Meeting Room Level	**Technical Sessions TU2** Convention Level & Meeting Room Level
15:30		***Break / Poster Session P1 / Exhibits*** Exhibit Halls B&C Convention Level	***Break / Poster Session P2 / Exhibits*** Exhibit Halls B&C Convention Level
16:00		**Techinical Sessions M3** Convention Level & Meeting Room Level	**Technical Sessions TU3** Convention Level & Meeting Room Level
17:30			
18:00 to 20:30	**Opening Ceremony & Welcome Reception** Exhibit Halls A,B&C Convention Level		
19:30 to 23:30			**International Fair** Exhibit Hall A, Ballrooms A,B&C Convention Level

Programme at a Glance

	WEDNESDAY	THURSDAY	FRIDAY
07:30	07:30-17:30 **Registration** Convention Lobby Convention Level	07:30-17:30 **Registration** Convention Lobby Convention Level	07:30-13:30 **Registration** Convention Lobby Convention Level
08:30	***Keynote Presentations*** **WK:** Gail M. Atkinson, Shunsuke Otani Exhibit Hall A Convention Level	***Keynote Presentations*** **THK:** Chris D. Poland, Anil K. Chopra Exhibit Hall A Convention Level	***Keynote Presentations*** **FK:** Gian Michele Calvi, Yuxian Hu Exhibit Hall A Convention Level
10:00	***Break / Poster Session P3 / Exhibits*** Exhibit Halls B&C Convention Level	***Break / Poster Session P4*** Exhibit Hall B Convention Level	***Break / Poster Session P5*** Exhibit Hall B Convention Level
10:30	**Technical Sessions W1** Convention Level & Meeting Room Level	**Technical Sessions TH1** Convention Level & Meeting Room Level	**Technical Sessions F1** Convention Level & Meeting Room Level
12:00	**Lunch/ Poster Session P3 / Exhibits** Exhibit Halls B&C Convention Level	**Lunch/ Poster Session P4** Exhibit Hall B Convention Level	**Lunch/ Poster Session P5** Exhibit Hall B Convention Level
12:30			
14:00	**Technical Sessions W2** Convention Level & Meeting Room Level	**Technical Sessions TH2** Convention Level & Meeting Room Level	**Technical Sessions F2** Convention Level & Meeting Room Level
15:30	***Break / Poster Session P3 / Exhibits*** Exhibit Halls B&C Convention Level	***Break / Poster Session P4*** Exhibit Hall B Convention Level	***Break / Poster Session P5*** Exhibit Hall B Convention Level
16:00	**Techinical Sessions W3** Convention Level & Meeting Room Level	**Techinical Sessions TH3** Convention Level & Meeting Room Level	**Closing Ceremonies**
17:30			
18:00			
		20:00-01:00 Enchanted Rainforest Banquet, Exhibit Hall A, Ballrooms A,B&C Convention Level	

Programme Overview

			ROOM
Sunday, August 1			
18:00 - 19:00		**Opening Ceremony** **Dignitary Welcomes**	*EH A*
19:00 - 20:30		**Welcome Reception**	*EH B&C*
Monday, August 2			
08:15 - 10:30			
MK	MTC 23	**KEYNOTE PRESENTATIONS:** Characterizing Pile Foundations for Evaluation of Performance Based Seismic Design of Critical Lifeline Structures (W.D. Liam Finn); Advances in Lifeline Earthquake Engineering (Thomas D. O'Rourke); Notes on the Seismic Adequacy of Vernacular Buildings (Jorge Gutierrez)	*EH A*
10:30 - 11:00		**Break / Poster Session P1 / Exhibits**	*EH B&C*
11:00 - 12:30			
M1-1	MTC 4	ENGINEERING SEISMOLOGY - 3D site effects	*BR A*
M1-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - General II	*BR B*
M1-3	MTC 6	STRUCTURAL ENGINEERING - ANALYSIS - Experimental/Analytical	*BR C*
M1-4	MTC 8	DESIGN CRITERIA AND METHODS - Base Isolation	*MR 1*
M1-5	MTC 6	STRUCTURAL ENGINEERING - CONTROL - Passive	*MR 2&3*
M1-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil Liquefaction and Remediation I	*MR 11&12*
M1-7	MTC 7	LIFELINE SYSTEMS -Design and Analysis of Lifelines	*MR 8&15*
M1-8	MTC 6	STRUCTURAL ENGINEERING - MASONRY AND TIMBER - General Timber	*MR 13*
M1-9	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Analysis	*EH A*
12:30 - 14:00		**Lunch / Poster Session P1 / Exhibits**	*EH B&C*

Programme Overview – *continued*

			ROOM
14:00 - 15:30			
M2-1	MTC 4	ENGINEERING SEISMOLOGY - *Attenuation and hazard modelling*	*BR A*
M2-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Columns I	*BR B*
M2-3	MTC 19	SPECIAL THEME SESSION - Seismic Response of Irregular Structures I	*BR C*
M2-4	MTC 6	STRUCTURAL ENGINEERING - BRIDGES - Long Span	*MR 1*
M2-5	MTC 6	STRUCTURAL ENGINEERING - CONTROL - Damping I	*MR 2&3*
M2-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil Liquefaction and Remediation II	*MR 11&12*
M2-7	MTC 7	LIFELINE SYSTEMS -Electric Power Lifelines	*MR 8&15*
M2-8	MTC 6	STRUCTURAL ENGINEERING - MASONRY AND TIMBER - General Masonry	*MR 13*
M2-9	MTC 27	SPECIAL SESSION - STATE OF THE ART REPORT ON EARTHQUAKE ENGINEERING ACTIVITIES IN JAPAN - JAEE I	*EH A*
15:30 - 16:00		**Break / Poster Session P1 / Exhibits**	*EH B&C*
16:00 - 17:30			
M3-1	MTC 4	ENGINEERING SEISMOLOGY - From ground motions to hazards	*BR A*
M3-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Columns II	*BR B*
M3-3	MTC 19	SPECIAL THEME SESSION - Seismic Response of Irregular Structures II	*BR C*
M3-4	MTC 6	STRUCTURAL ENGINEERING - BRIDGES - Experimental Response	*MR 1*
M3-5	MTC 6	STRUCTURAL ENGINEERING - CONTROL - Damping II	*MR 2&3*
M3-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil Liquefaction and Remediation III	*MR 11&12*
M3-7	MTC 7	LIFELINE SYSTEMS -Performance of Lifelines	*MR 8&15*
M3-8	MTC 6	STRUCTURAL ENGINEERING - MASONRY AND TIMBER - Masonry Retrofit	*MR 13*
M3-9	MTC 27	SPECIAL SESSION - STATE OF THE ART REPORT ON EARTHQUAKE ENGINEERING ACTIVITIES IN JAPAN - JAEE II	*EH A*

Tuesday, August 3

			ROOM
08:30 - 10:00			
TUK	MTC 23	KEYNOTE PRESENTATIONS: Political Activities of Earthquake Engineers for Seismic Risk Mitigation? (Hugo Bachmann); Earthquake Disaster Risk Mitigation Before and After the 1995 Kobe Earthquake (Tsuneo Katayama)	*EH A*
10:00 - 10:30		**Break / Poster Session P2 / Exhibits**	*EH B&C*
10:30 - 12:00			
TU1-1	MTC 4	ENGINEERING SEISMOLOGY - Strong motion arrays	*BR A*
TU1-2	MTC 8	DESIGN CRITERIA & METHODS - Design of Inelastic Systems	*BR B*
TU1-3	MTC 24	OVERVIEW SESSION - Network for Earthquake Engineering Simulation (NEES)	*BR C*
TU1-4	MTC 6	STRUCTURAL ENGINEERING - MISCELLANEOUS - Design	*MR 1*
TU1-5	MTC 22	SPECIAL THEME SESSION - Centrifuge Liquefaction Studies	*MR 2&3*
TU1-6	MTC 2	EARTHQUAKE ENGINEERING PRACTICE - Bridges	*MR 11&12*
TU1-7	*MTC 7*	LIFELINE SYSTEMS - Water and Transportation Lifelines	*MR 8&15*
TU1-8	MTC 10	OTHER ISSUES - Architectural Considerations	*MR13*
TU1-9	MTC6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Frames	*EH A*
12:00 - 14:00		**Lunch / Poster Session P2 / Exhibits**	*EH B&C*
14:00 - 15:30			
TU2-1	MTC 4	ENGINEERING SEISMOLOGY - Ground motion intensity and damage	*BR A*
TU2-2	MTC 27	SPECIAL SESSION - SEISMIC RISK REDUCTION AND DISASTER PREPAREDNESS FOR MAJOR URBAN CENTERS I	*BR B*
TU2-3	MTC 16	SPECIAL THEME SESSION - Using the Network for Earthquake Engineering Simulation (NEES) Collaboratory to Advance Earthquake Engineering - Overview of NEES grid	*BR C*
TU2-4	MTC 11	SPECIAL THEME SESSION - Seismic Aspects of Large Dams - Introduction and Embankment Dams	*MR 1*

Programme Overview – *continued*

			ROOM
TU2-5	MTC 18	SPECIAL THEME SESSION - Future of Building Codes I	*MR 2&3*
TU2-6	MTC 5	GEOTECHNICAL ENGINEERING - Earth and Rockfill Dams	*MR 11&12*
TU2-7	MTC 7	LIFELINE SYSTEMS - Pipelines and Other Buried Lifelines	*MR 8&15*
TU2-8	MTC 1	EARTHQUAKE RISK REDUCTION - Developing Countries	*MR 13*
15:30 - 16:00		**Break / Poster Session P2 / Exhibits**	*EH B&C*
16:00 - 17:30			
TU3-1	MTC 4	ENGINEERING SEISMOLOGY - Near-fault ground motions and hazard	*BR A*
TU3-2	MTC 27	SPECIAL SESSION - SEISMIC RISK REDUCTION AND DISASTER PREPAREDNESS FOR MAJOR URBAN CENTERS II	*BR B*
TU3-3	MTC 16	SPECIAL THEME SESSION - Using the Network for Earthquake Engineering Simulation (NEES) Collaboratory to Advance Earthquake Engineering - Four sample applications of NEES Grid Systems Integration with testing sites	*BR C*
TU3-4	MTC 11	SPECIAL THEME SESSION - Seismic Aspects of Large Dams - Concrete Dams and Discussion	*MR 1*
TU3-5	MTC 18	SPECIAL THEME SESSION - Future of Building Codes II	*MR 2 & 3*
TU3-6	MTC 5	GEOTECHNICAL ENGINEERING - Retaining Structures and Bridge Foundations	*MR 11&12*
TU3-7	MTC 2	EARTHQUAKE ENGINEERING PRACTICE - Building Retrofitting	*MR 8&15*
TU3-8	MTC 1	EARTHQUAKE RISK REDUCTION - General	*MR 13*
19:30 - 23:30		**International Fair**	*EH A, BR A,B&C*

Wednesday, August 4

			ROOM
08:30 - 10:00			
WK	MTC 23	**KEYNOTE PRESENTATIONS:** An Overview of Developments in Seismic Hazard Analysis (Gail M. Atkinson); Japanese Seismic Design of High-rise Reinforced Concrete Buildings - An Example of Performance-based Design Code and State of Practices (Shunsuke Otani)	*EH A*
10:00 - 10:30		**Break / Poster Session P3 / Exhibits**	*EH B&C*
10:30 - 12:00			
W1-1	MTC 4	ENGINEERING SEISMOLOGY - From site effects to hazard assessment	*BR A*
W1-2	MTC 6	STRUCTURAL ENGINEERING - STEEL - Connections	*BR B*
W1-3	MTC 6	STRUCTURAL ENGINEERING - ANALYSIS - Nonlinear	*BR C*
W1-4	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - General	*MR 1*
W1-5	MTC 9	LESSONS FROM RECENT EARTHQUAKES - Damage	*MR 2 & 3*
W1-6	MTC 5	GEOTECHNICAL ENGINEERING - Numerical Soil Models and Analysis	*MR 11&12*
W1-7	MTC 14	SPECIAL THEME SESSION - Indigenous Earthquake-Resistant Technologies	*MR 8&15*
W1-8	MTC 6	STRUCTURAL ENGINEERING - BRIDGES - Isolation	*MR 13*
W1-9	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Walls	*EH A*
12:00 - 14:00		**Lunch / Poster Session P3 / Exhibits**	*EH B&C*
14:00 - 15:30			
W2-1	MTC 4	ENGINEERING SEISMOLOGY - Seismic hazard evaluation and mapping I	*BR A*
W2-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Joints	*BR B*
W2-3	MTC 21	SPECIAL THEME SESSION - Seismic Structural Design in Regions of Moderate Seismicity I	*BR C*
W2-4	MTC 15	SPECIAL THEME SESSION - Site Characterization for Site Effect Studies Using Ambient Vibrations I	*MR 1*
W2-5	MTC 6	STRUCTURAL ENGINEERING - CONTROL - Testing	*MR 2 & 3*

Programme Overview – *continued*

			ROOM
W2-6	MTC 5	GEOTECHNICAL ENGINEERING - Laboratory Testing of Soils	*MR 11&12*
W2-7	MTC 9	LESSONS FROM RECENT EARTHQUAKES - Evaluation and Reconstruction	*MR 8&15*
W2-8	MTC 1	EARTHQUAKE RISK REDUCTION - Regulatory Issues	*MR 13*
W2-9	MTC 27	SPECIAL SESSION - 2003 Bam Earthquake in Iran	*EH A*
15:30 - 16:00		**Break / Poster Session P3 / Exhibits**	*EH B&C*
16:00 - 17:30			
W3-1	MTC 4	ENGINEERING SEISMOLOGY - Seismic hazard evaluation and mapping II	*BR A*
W3-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Joints & Confinement	*BR B*
W3-3	MTC 21	SPECIAL THEME SESSION - Seismic Structural Design in Regions of Moderate Seismicity II	*BR C*
W3-4	MTC 15	SPECIAL THEME SESSION - Site Characterization for Site Effect Studies Using Ambient Vibrations II	*MR 1*
W3-5	MTC 22	STRUCTURAL ENGINEERING - Control Isolation	*MR 2&3*
W3-6	MTC 6	STRUCTURAL ENGINEERING - MISCELLANEOUS - Analysis	*MR 11&12*
W3-7	MTC 2	EARTHQUAKE ENGINEERING PRACTICE - Other Retrofitting	*MR 8&15*
W3-8	MTC 1	EARTHQUAKE RISK REDUCTION - Urban Environments	*MR 13*
W3-9	MTC 27	SPECIAL SESSION - Lessons Learned from Recent Earthquakes	*EH A*

Thursday, August 5

			ROOM
08:30 - 10:00			
THK	MTC 23	**KEYNOTE PRESENTATIONS:** Making Performance Based Engineering Useful (Chris D.Poland); Estimating Seismic Demands for Performance-Based Engineering of Buildings (Anil K. Chopra)	*EH A*
10:00 - 10:30		**Break / Poster Session P4**	*EH B*
10:30 - 12:00			
TH1-1	MTC 4	ENGINEERING SEISMOLOGY - Site effects and liquefaction	*BR A*
TH1-2	MTC 6	STRUCTURAL ENGINEERING - STEEL - Frames	*BR B*
TH1-3	MTC 8	DESIGN CRITERIA AND METHODS - Building Codes	*BR C*
TH1-4	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Retrofit	*MR 1*
TH1-5	MTC 6	STRUCTURAL ENGINEERING - EXPERIMENTAL - Full Scale and Pseudo Dynamic	*MR 2&3*
TH1-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil-Foundation Interaction I	*MR 11&12*
TH1-7	MTC 3	SOCIAL AND ECONOMIC ISSUES - Infrastructure Loss Modelling	*MR 8&15*
TH1-8	MTC 10	OTHER ISSUES - Historical	*MR 13*
TH1-9	MTC 8	DESIGN CRITERIA AND METHODS - Performance-Based Design	*EH A*
12:00 - 14:00		**Lunch / Poster Session P4**	*EH B*
14:00 - 15:30			
TH2-1	MTC 20	SPECIAL THEME SESSION - Strong Motion Prediction Considering the Effects of Surface Geology I	*BR A*
TH2-2	MTC 8	DESIGN CRITERIA AND METHODS - Displacement-Based Design	*BR B*
TH2-3	MTC 6	STRUCTURAL ENGINEERING - STEEL -General I	*BR C*
TH2-4	MTC 12	SPECIAL THEME SESSION - Buckling Restrained Braces for Rational Seismic Design	*MR 1*
TH2-5	MTC 6	STRUCTURAL ENGINEERING - EXPERIMENTAL - Shake Table	MR 2&3
TH2-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil-Foundation Interaction II	*MR 11&12*

Programme Overview – *continued*

			ROOM
TH2-7	MTC 3	SOCIAL AND ECONOMIC ISSUES - Insurance and Loss Estimation	*MR 8&15*
TH2-8	MTC 6	STRUCTURAL ENGINEERING - CONTROL - Sliding Isolation	*MR 13*
15:30 - 16:00		**Break / Poster Session P4**	*EH B*
16:00 - 17:30			
TH3-1	MTC 20	SPECIAL THEME SESSION - Strong Motion Prediction Considering the Effects of Surface Geology II	*BR A*
TH3-2	MTC 8	DESIGN CRITERIA AND METHODS - Reinforced Concrete Design	*BR B*
TH3-3	MTC 6	STRUCTURAL ENGINEERING - STEEL - Bracing	*BR C*
TH3-4	MTC 8	DESIGN CRITERIA AND METHODS - Non-Building Design	*MR 1*
TH3-5	MTC 13	SPECIAL THEME SESSION - Seismic Risk Reduction of Operational and Functional Components of Buildings	*MR 2&3*
TH3-6	MTC 5	GEOTECHNICAL ENGINEERING - Soil-Foundation Interaction III	*MR 11&12*
TH3-7	MTC 2	EARTHQUAKE ENGINEERING PRACTICE - General	*MR 8&15*
TH3-8	MTC 6	STRUCTURAL ENGINEERING - CONTROL - General	*MR 13*
20:00 - 01:00		**Enchanted Rainforest Banquet**	*EH A, BR A,B&C*

Friday, August 6

			ROOM
08:30 - 10:00			
FK	MTC 23	**KEYNOTE PRESENTATIONS:** Recent Experience and Innovative Approaches in Design and Assessment of Bridges (Gian Michele Calvi); Development of Earthquake Engineering in China (Yuxian Hu)	*EH A*
10:00 - 10:30		**Break / Poster Session P5**	*EH B*
10:30 - 12:00			
F1-1	MTC 4	ENGINEERING SEISMOLOGY - Subduction earthquakes and long-period hazard	*BR A*
F1-2	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Damage	*BR B*
F1-3	MTC 6	STRUCTURAL ENGINEERING - ANALYSIS - General I	*BR C*
F1-4	MTC 6	STRUCTURAL ENGINEERING - REINFORCED CONCRETE - Fibre Reinforcing	*MR 1*
F1-5	MTC 6	STRUCTURAL ENGINEERING - EXPERIMENTAL - General	*MR 2&3*
F1-6	MTC 5	GEOTECHNICAL ENGINEERING - Ground Motions & Site Effects	*MR 11&12*
F1-7	MTC 3	SOCIAL AND ECONOMIC ISSUES - Preparedness and Recovery	*MR 8&15*
F1-8	MTC 6	STRUCTURAL ENGINEERING - MISCELLANEOUS - Evaluation and Retrofit	*MR 13*
12:00 - 14:00		**Lunch / Poster Session P5**	*EH B*
14:00 - 15:30			
F2-1	MTC 4	ENGINEERING SEISMOLOGY - Urban strong motion	*BR A*
F2-2	MTC 8	DESIGN CRITERIA AND METHODS - Seismic Codes and Standards	*BR B*
F2-3	MTC 6	STRUCTURAL ENGINEERING - ANALYSIS - General II	*BR C*
F2-4	MTC 17	SPECIAL THEME SESSION - Hybrid Experimental and Analytical Simulation in Earthquake Engineering	*MR 1*
F2-5	MTC 6	STRUCTURAL ENGINEERING - MISCELLANEOUS - Performance	*MR 2&3*
F2-6	MTC 8	DESIGN CRITERIA AND METHODS - Design - Site Effects	*MR 11&12*

Programme Overview – *continued*

			ROOM
F2-7	MTC 3	SOCIAL AND ECONOMIC ISSUES - Urban Planning and Risk Analysis	*MR 8&15*
F2-8	MTC 6F	OTHER ISSUES - Non-Structural Elements and Industrial Facilities	*MR 13*
15:30 - 16:00		**Break / Poster Session P5**	*EH B*
16:00 - 17:30			
F3-9		**Closing Ceremonies**	*EH A*